

On New and Old-Known Oligochaeta Genera from Paraiba State, Brazil

Gilberto RIGHI

Dept. Zoologia, Universidade de São Paulo,
Caixa Postal 20520; 01452-990 S. Paulo, Brazil.

On New and Old-Known Oligochaeta Genera from Paraiba State, Brazil. – The Glossoscolecidae *Cirodrilus aidae* n. sp. is described. The Ocnerodrilidae genera *Ocnerodrilus* and *Liodrilus* are reevaluated. *O. potyura* n. sp. and *L. mendesi* n. sp. are described. *Lourdesia* n. gen., near to *Ilyogenia* and *Temanonegia*, is established for *L. paraibaensis* n. sp. All studied species came from Paraiba State, Brazil.

Key-words: Oligochaeta - Glossoscolecidae - Ocnerodrilidae - Taxonomy - Brazil.

INTRODUCTION

I am very grateful to Dr. Rafael Angel Torquemada Guerra (Federal University of Paraiba, Brazil) for the opportunity of studying this very interesting earthworms collection from Paraiba State, Brazil, and to Dr. John Milton (University of São Paulo) for English language corrections.

Since the beginning of the century the genera *Ocnerodrilus* and *Liodrilus* have received several inconsistent interpretations so that they need an anatomical reevaluation to establishing their characteristics and their boundaries from *Ilyogenia* and *Gordiodrilus*, which make with them a very homogeneous group with African and American representatives.

MATERIAL AND METHODS

The animals were collected manually and fixed by formalin 10%. The studies were made by dissections, pieces mounted in glycerin-water (1:1) and serial microscopical sections (10 µm) stained by Mallory's triple method (PANTIN, 1964).

The figures were made with camera lucida. A part of the material is deposited in the Department of Zoology - University of S. Paulo (ZU) and the other part is in the Muséum d'Histoire naturelle Genève (MHNG).

GLOSSOSCOLECIDAE

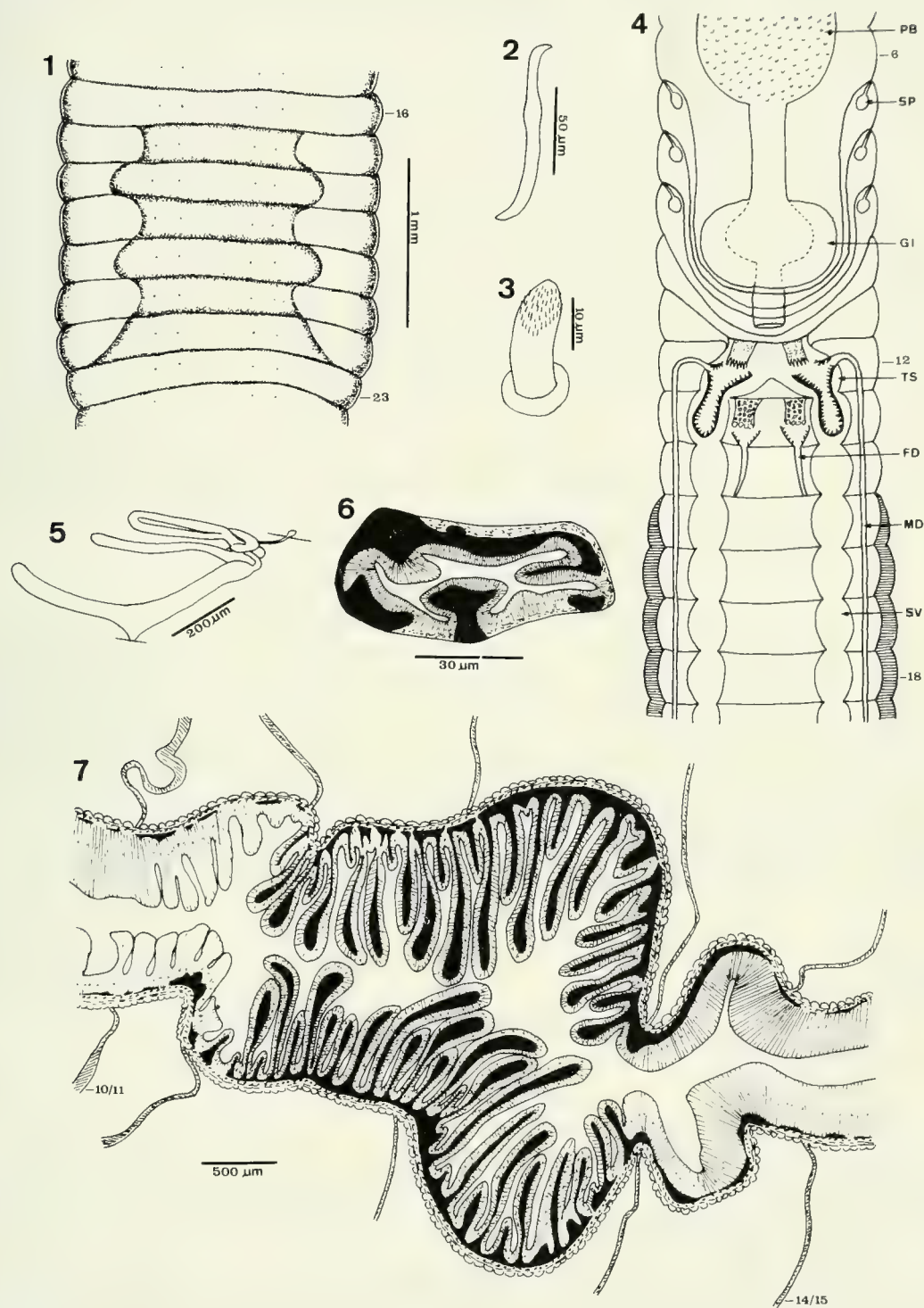
Cirodrilus aidae, n. sp.

(Figs 1-8)

MATERIAL - Brazil: Paraíba State. João Pessoa, sand soil with a low moisture, 1 clitellate specimen (Holotype ZU-1272A) and 2 clitellate specimens (Paratypes ZU-1272B; MHNG-992-133), Everaldo G. da Silva col. 22.II.1992.

DESCRIPTION - Length 42 - 52 mm. Mid-body diameter 1.2 - 1.3 mm. Number of segments 191 - 215. There are no pigments. The short tentacular prostomium and the rudimentary segment I are invaginated. The segment II has numerous thin longitudinal grooves and a pair of nephribuccal furrows. The setae are arranged in 4 pairs of regular lengthwise series from II to the back. The setal relations are in the middle-body region (segments LXX - LXXX) $aa : ab : bc : cd : dd = 4.3 : 1.0 : 5.5 : 1.0 : 18.5$ and in the posterior region (CLXX - CLXXX) $= 3.5 : 1.0 : 3.5 : 1.0 : 10.3$, in both regions $ab = 80 \mu\text{m}$. The setae are lengthened sigmate; their nodulus is slightly distal (Fig. 2) and the convex sub-apical surface has a wide group of small thorns (Fig. 3). The setae length varies from 102 - 118 μm throughout the body. There are no differentiated genital setae. The clitellum is saddle-shaped on segments XV - XXIV (= 10). One pair of puberal ridges extends from XVII - XXII (fig. 1); the medial margin of the ridges is wavy at the side of the setae *b* line and the lateral margin is straight on the nephridiopore line. The ridges are associated with glandular clusters which protrude slightly into the body cavity. The ventral body surface between the puberal ridges is thickened in XVII, XIX and XXI. The nephridiopores are intersegmental in *cd*. The genital pores are microscopical. The male pores lie in the ventral half of the puberal ridges in the posterior region of XVIII. The female pores are in the posterior half of XIV aligned with setae *a*. Three pairs of spermathecal pores are in *cd* of 6/7 - 8/9.

The septa are thin and fragile, mainly the 6/7 - 8/9; septa 6/7 - 10/11 are like interpenetrated cones and the others are flat. One rounded and strongly muscular gizzard lies in the cavity of VI but, due to its size and to the septa shape, it corresponds to parietal segments IX - X (Fig. 4). Two pairs of calciferous glands open into the posterior region of the oesophagus in VIII and IX at the sides of its mid-ventral line. They are small club-shaped and hidden by the oesophagus; the glands are curved forward and downward in VIII and forward and upward in IX. The glands have a wavy slit-like cavity circumscribed by 3 - 5 parietal longitudinal trabeculae of variable height and width (Fig. 6). The oesophagus swells in XII and much more in XIII. In these segments the inner oesophageal surface, excepting for its mid-dorsal and mid-ventral lines, is raised up in very numerous high and very vasculose transverse lamellae (Fig. 7) making an intramural calciferous tissue. The transition



FIGS 1-7

Cirodrilus angeioi: 1. Ventral surface of the segments XVI - XXIII. 2. Posterior seta. 3. Apex of one seta. 4. Diagram of the organization of the segments VI - XVIII, reconstructed from serial sections. 5. Post-clitellar nephridium. 6. Mid cross section of a calciferous gland. 7. Horizontal section of the oesophagus in XI - XIV. FD - female duct. GI = gizzard. PB = pharyngeal bulb. MD = male duct. SP = spermatheca. SV = seminal vesicle.

oesophagus-intestine is in 16/17. The typhlosole begins in XVIII; it is a longitudinally wavy dorsal blade as high as 1/4 of the intestinal diameter. There are no intestinal caeca. Three pairs of thin lateral-hearts are in VII - IX and two pairs of bulky oesophageal-hearts link the mid-dorsal line of the oesophageal blood-plexus with the ventral vessel in X and XI. There is one holonephridia pair in each segment. The post-clitellar nephridia (Fig. 5) have a minute preseptal funnel connected with the post-septal main portion, which is composed of two loops united to the mid-ventral extremity of the bladder.

The pair of testes is attached to the posterior face of the conic septum 10/11 so that the ventrally coalesced testis sacs protrude laterally into the space of the parietal segments XII-XIII (Fig. 4). The pair of band-like seminal vesicles presents strong intersegmental constrictions; the vesicles continue laterally to the intestine to LIX. The pair of male ducts is superficial on the body wall to XVI and intraparietal at the back. The pair of ovaries and female funnels are ventral in XIII. The ovaries are wide with the eggs irregularly distributed. The spermathecae (Fig. 8) have a well demarcated globular ampulla and a slightly shorter duct.

REMARKS - The genus *Cirodrilus* Righi, 1975 had only one species, *C. angeloi* Righi, 1975 known from Brazil, Amapá State. The two now known species are distinguished by the following characteristics: *C. aidae* - puberal ridges in XVII-XXII (*C. angeloi* - puberal ridges in XIV, XV-XXI); genital setae absent (genital setae present); common setae ornamented with a wide group of thorns (with 6 aligned thorns); male pores in the posterior half of XVIII (in the posterior half of XVI); spermathecae pores in 6/7 - 8/9 (in 5/6 - 8/9); intramural calciferous glands in XII - XIII (in X - XIV).

The name of the new species was given in memory of Mrs. Aida Prioli Righi.

OCNERODRILIDAE

Ocnerodrilus Eisen, 1878

Ocnerodrilus Eisen, 1878: 1

Ocnerodrilus (part.); EISEN, 1893: 272; 1900: 110; BEDDARD, 1895: 510; MICHAELSEN, 1900: 377; COGNETTI, 1905b: 50; STEPHENSON, 1923: 484; 1930: 860; GATES, 1972: 273; 1973: 23, 25; RIGHI, 1990: 69.

DIAGNOSIS - Eight setae per segment. Dorsal pores absent. One pair of prostate pores in 1/2 XVII and one pair of male pores (vasa deferentia openings) close or coalesced with the prostate ones; or male pores in 17/18 united to the prostate ones by short seminal grooves; or two pairs of prostate pores in XIX and XX and one pair of male pores coalesced with the first pair of prostate pores. Gizzard absent. One pair of calciferous glands in IX with separated oesophageal openings, exceptionally with a common opening. The calciferous gland cavity is wide and undivided and has a number of independent lengthwise parietal-lamellae or folds; exceptionally the cavity is smooth. Two pairs of testis and male funnels in X and XI. Prostates, one pair in XVII or absent, occasionally two pairs in XIX and XX. Ovaries, one pair in XIII.

Spermathecae, one pair in 8/9 without diverticles or seminal chambers or spermathecae absent.

TYPE - *Ocnerodrilus occidentalis* Eisen, 1878.

SPECIES AND OCCURRENCES

O. paraguayensis Rosa, 1895 - Paraguay: Central Prov.: Assuncion (ROSA, l.c.; 1896). Argentina: Jujuy Prov.: San Lorenzo. Bolivia: Santa Cruz Dept.: Aguajrenda (COGNETTI, 1902).

O. ibemi Righi, 1968 - Brazil: São Paulo State: São Sebastião (RIGHI, l.c.).

O. simplex Cognetti, 1904 - Costa Rica: San Jose (COGNETTI, l.c.; 1905b). Canary Islands (COGNETTI, 1906).

O. potyuara, n. sp. - Brazil: Paraíba State: Mari.

O. calwoodi Michaelsen, 1899 - Caribbean Islands: St. Thomas (Michaelsen, l.c.); Cuba (MICHAELSEN, 1924). Colombia: Antioquia Dept.: near Medellin (MICHAELSEN, 1913). Canary Islands (COGNETTI, 1906).

O. jeanneli Michaelsen, 1914 - Kenya: Mount Kenya (MICHAELSEN, l.c.; 1915).

O. occidentalis Eisen, 1878 - Worldwide in tropical and hot-temperate zones (RIGHI, 1984).

O. andinus Righi, 1981 - Ecuador: Pichincha Dept.: Los Tayos Cave near Quito (RIGHI, l.c.).

O. cunningtoni Beddard, 1906 - Zaire: Lake Tanganyika (BEDDARD, l.c.).

O. sabanae Cognetti, 1905 - Panama: Darien: Punta de Sabana (COGNETTI, 1905a, b).

O. alox Righi & Fraile-Merino, 1987 - Costa Rica: Heredia Prov.: San Francisco (RIGHI & FRAILE-MERINO, l.c.).

O. overlaeti (Michaelsen, 1936) - Zaire: Sandoa (MICHAELSEN, l.c.).

REMARKS

1. - STEPHENSON (1930) recognized three subgenera of *Ocnerodrilus* (viz. *Ocnerodrilus s.s.*, *Ilyogenia* Beddard, 1892 and *Liodrilus* Eisen, 1900) distinguished by the number (0, 1 or 2 pairs) and position (7/8 or 7/8 and 8/9 intersegments) of the spermathecae, seminal vesicles (present or absent) and spermatozoan maturation (intra- or extra-gonadal). JAMIESON (1971) elevated the subgenera to genera rank. The distinction of subgenera or genera based upon negative characteristics or on characteristics associated with non-crossed reproduction had to be made because of the type-species, *Ocnerodrilus occidentalis* were known only through morphs with very degenerated sexual apparatus. The finding of an *O. occidentalis* population of degenerated and undegenerated specimens and the study of some new *Ocnerodrilus* species (RIGHI, 1981; 1984; RIGHI & FRAILE-MERINO, 1987) showed that the sexual organs, especially the spermathecae, have some meaning in distinguishing the three genera. However the closest affinities between the species are seen in the calciferous

glands structure as follow: the cavity of the calciferous glands in *Ocnerodrilus* is undivided and its inner surface is smooth or pleated lengthwise. The glandular cavity in *Ilyogenia* is divided by longitudinal ridges merged medially; it results a system of longitudinal chambers or tubes placed around a "solid" core. The glands of *Liodrilus* have a paniced-tubular structure (see below).

2. - The structure of the calciferous glands is unknown to *O. paraguayensis*, *O. ibemi*, *O. simplex* and *O. sabanae*. It was assumed they have the *Ocnerodrilus* trabecular type because the first three species have affinities with *O. calwoodi* and the last one with *O. alox*.

3. - *O. overlaetti* has a single position in *Ocnerodrilus* owing to its two pairs of prostates in XIX and XX and the vasa deferentia opening coalescing with the first prostatic pores. Therefore MICHAELSEN (1936) described it in the unharmonious genus *Gordiodrilus*; where it was the only species with a pair of calciferous glands. The number of calciferous glands and presence of spermathecae led JAMIESON (1963) to transfer *overlaetti* into *Ilyogenia*; from where it was now removed to *Ocnerodrilus* by the calciferous gland structure.

4. - *O. cunningtoni* (with the two calciferous glands confluent into a common oesophageal opening) has an intermediary position between *Ocnerodrilus* (with two independent calciferous glands) and *Gordiodrilus* (with an odd calciferous gland).

5. - *O. alox* shows a slight inner division in the ental portion of its calciferous glands. This reinforces the idea of the relationship among *Ocnerodrilus*, *Ilyogenia* and *Liodrilus*. The occurrence of *O. alox* in Central America (Costa Rica) is coincident with the *Ilyogenia* territory and is not far away from *Liodrilus* region, which goes from Guyana to NE Brazil (Pará and Paraíba States).

6. - The chambers inside the spermathecae duct of *O. potyuara* (see below) may be seen as a preliminary sketch of the diverticula; which characterize *Pygmaeodrilus*. Moreover the occurrence of *O. potyuara* in NE Brazil is not far away from *Pygmaeodrilus amapaensis* Righi, 1988, known from Amapá State, Brazil.

7. - The genus *Ocnerodrilus* (without the anthropochoric species) is found in Central and South America and in Africa. The American occurrences are in Argentina (Jujuy Prov.), Paraguay, Bolivia (Santa Cruz Dept.), Brazil (S. Paulo and Paraíba States), Equador (Pichincha Dept.), Colombia (Antioquia Dept.), Costa Rica and the Caribbean Islands (St. Thomas and Cuba). The African occurrences are in Kenya and Zaire. Amphiatlantic distribution among the Ocnerodrilidae is also known to *Ilyogenia* (Stephenson, 1930), *Pygmaeodrilus* (Righi, 1988) and *Gordiodrilus* (Righi, 1990). Similarities in the anatomy and in the geographical distribution of these four genera suggest they make up a closely related group, very old (before the Atlantic opening), and which have a very slow evolutionary rate.

8. - The structure of the calciferous glands is a valuable practical characteristics to distinguish the genera *Ocnerodrilus*, *Ilyogenia* and *Liodrilus*. However I am not quite sure about its applicability to recognize the philetic relationships between the other Ocnerodrilidae genera. The descriptive anatomy of the calciferous glands of *Ocnerodrilus potyuara*, *Liodrilus mendesi* and *Lourdesia paraibaensis* (see below) and the comparative anatomy (*O. alox* presents slight ental division of the

glands cavity) suggest that the growing and differentiation of the calciferous gland is a phenomenon of their apical region, i.e. ental. So it is easy to understand that the structural type of unilocular wide cavity with or without lengthwise parietal trabeculae or folds, presented by *Ocnerodrilus*, is the simplest one. The medial coalescence of the trabeculae would give rise to the plurilocular type with the "solid" core of *Ilyogenia*. And several longitudinal coalescences of the trabeculae would give the paniced-tubular structure of *Liodrilus*. Fusion of the gland pair into an odd calciferous gland and thickening of its stroma leaving a thin axial cavity would give the *Gordiodrilus* type. However the other genus of the group, *Pygmaeodrilus*, is characterized by the spermathecal diverticles and not by its calciferous glands structure (JAMIESON, 1957). Some *Pygmaeodrilus* species have glands of the *Ocnerodrilus* type (viz. *P. budduensis* Michaelsen, 1911), others species have the *Ilyogenia* type (viz. *P. quilimanensis* Michaelsen, 1890) and others the *Gordiodrilus* type (viz. *P. amapaensis* Righi, 1988). This makes us to conclude that the spermathecae diverticles or the calciferous glands structural type would have originated more than one time. In any case *Pygmaeodrilus* is not an homogeneous grouping.

KEY TO *Ocnerodrilus* SPECIES

- 1 Prostates, two pairs in XIX and XX *O. overlaeti*
- Prostates, one pair in XVII 2
- 2 One pair of short seminal furrows uniting the prostatic pores in 1/2 XVII to the male pores (vasa deferentia openings) in 17/18 3
- Prostate and male pores side by side or coalesced in 1/2 XVII 4
- 3 Wide glandular cushion in XVII. Ampulla and duct of the spermathecae well demarcated *O. alox*
- Glandular cushion absent. Spermathecae without distinction between ampulla and duct *O. sabanae*
- 4 Spermathecae absent *O. occidentalis*
- Spermathecae present 5
- 5 Setae bicuspidate. Calciferous gland with a common oesophageal opening *O. cunningtoni*
- Setae unicuspidate. Calciferous glands with independent opening 6
- 6 Calciferous glands cavity of smooth surface, i.e. without trabeculae or folds *O. andinus*
- Calciferous glands cavity with lengthwise trabeculae or folds 7
- 7 Setae a and b of XVII present *O. occidentalis*
- Setae a and / or b of XVII absent 8
- 8 In the mid-body region $aa = bc$ 9
- In the mid-body region $aa > bc$ 10
- 9 Vasa deferentia with distal muscular thickening *O. jeanneli*
- Vasa deferentia without distal muscular thickening *O. calwoodi*
- 10 Arciform musculature (intracoelomic oblique muscle bands) in one or more segments from XV - XVIII associated with ventral depression of the clitellum 11

- Arciform musculature absent; ventral surface of the clitellum is not depressed 12
- 11 Spermathecae with well demarcated ampulla and duct. Arciform musculature in XV - XVIII *O. potyuara*
- Spermathecae without distinction between duct and ampulla. Arciform musculature in XVII *O. simplex*
- 12 Wide glandular cushion in XVII. Prostates with well demarcated duct and gland *O. ibemi*
- Glandular cushion absent. Prostates without distinction between duct and gland. *O. paraguayensis*

Ocnerodrilus potyuara, n. sp.

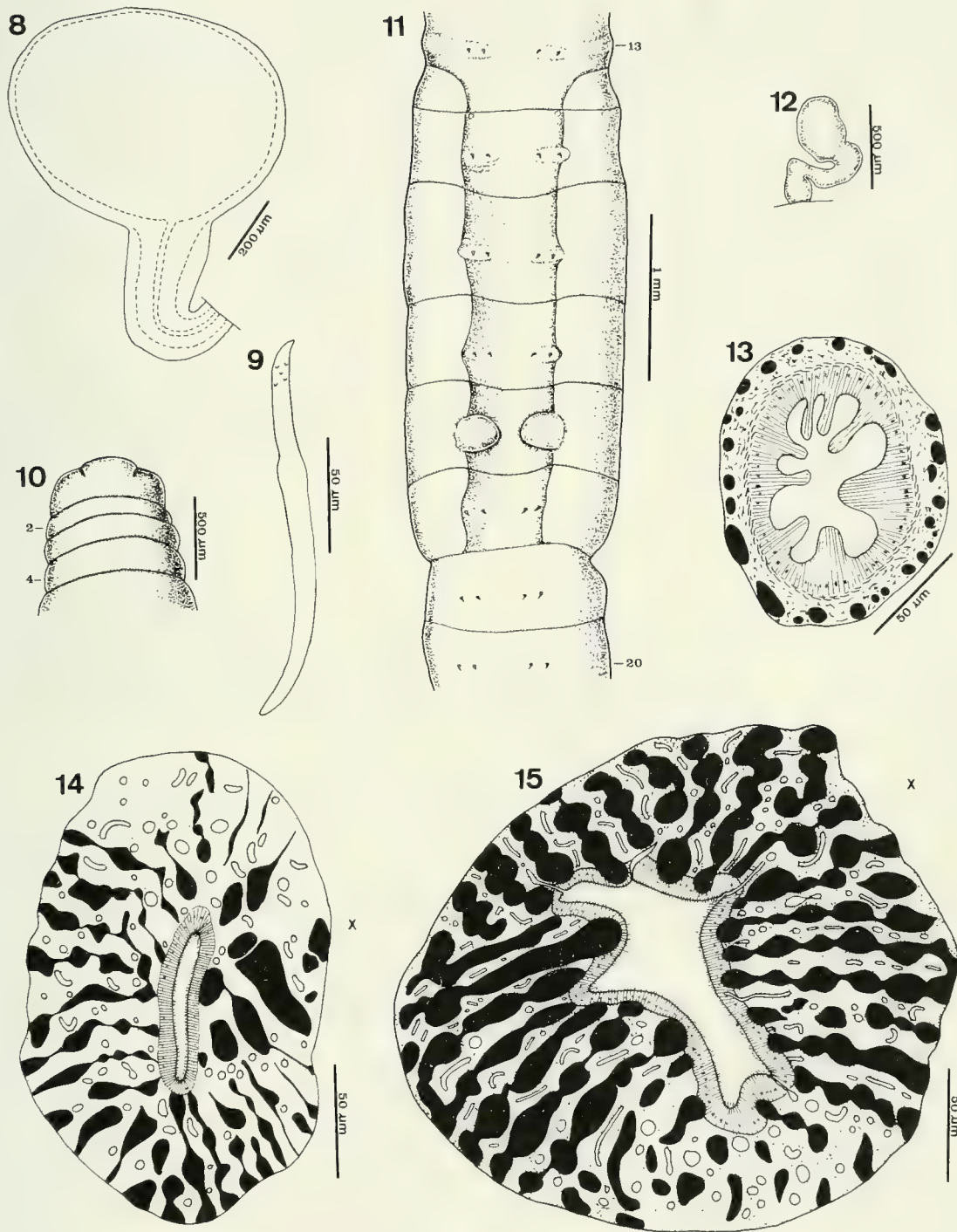
(Figs 9-15)

MATERIAL - Brazil: Paraiba State: Mari, moist sandy soil with sweet-potato tillage near a dam, holotype 1 clitellate worm (ZU-1276A), paratypes 2 clitellate and 2 mature a clitellate worms (ZU-1276B), 1 clitellate and 2 mature a clitellate worms (MHNG 990.124)); Rafael A. T. Guerra col. 24.XI.1990.

DESCRIPTION - The clitellate worms are 28 - 57 mm long by 0.9 - 1.1 mm wide in the middle-body region. Number of segments 87 - 165. There are no pigments. The prostomium (Fig. 10) is epilobitic 1/3 of open tongue. The setae start from II and are arranged in regular lengthwise rows. There are no ventral setae in XVII or modified genital setae. The relationships between the setae are in the mid-body region (segments XXV - XXX) $aa : ab : bc : cd : dd = 3.1 : 1.0 : 5.0 : 0.9 : 16.6$ ($ab = 90 \mu\text{m}$) and in the posterior region (XC - C) $= 3.8 : 1.0 : 3.9 : 1.0 : 11.5$ ($ab = 77 \mu\text{m}$). The setae (Fig. 9) are sigmoid, unicuspidate, with a small distal nodulus. The subapical portion of the mid-body setae has some semilunar excavations open to the apex and irregularly placed. The greater number of posterior setae are smooth, i.e. not ornamented. The setae length varies in the mid-body region from 148 - 186 μm ($M = 161 \mu\text{m}$) and in the posterior region from 126 - 141 μm ($M = 134 \mu\text{m}$).

The saddle-shaped clitellum is ventrally open in *bb*; it extends from 1/3 XIII, XIV - XVIII (= 5 - 5 1/3 segments); its intersegmental furrows are inconspicuous. The ventral surface of XV, XVI - XVIII (Fig. 11) varies from slightly to very depressed. This is related to the oblique muscle bands (arciform muscles) running from the ventral to the lateral body walls in the coelomic cavity of XV - XVIII. The male pores are situated on a pair of rounded to egg-shaped papillae in *ab* of XVII. The female pores lie on two minute milk-white papillae in line *c* just after intersegment 13/14. One pair of spermathecal pores open on line *b* of 8/9, inside a small egg-like area. The nephridiopore were unrecognized.

The septa 6/7 - 8/9 are very thick and muscly, the 5/6 a little less and the others are thin and fragile. Septal glands are well developed in V - VIII; they diminish in size from front to rear. The gizzard is absent. The pair of calciferous glands open ventro-laterally into the posterior region of the oesophagus in IX. Each gland has a short peduncle pointing downwards. It continues forwards by the egg-shaped gland



FIGS 8-15

Cirodrilus angeloi: 8. Spermatheca of 6/7. *Ocnerodrilus potyvara*: 9. Mid-body seta. 10. First four segments in dorsal view. 11. Ventral surface of the segments XIII - XX. 12. Spermatheca. 13. Cross section of the spermatheca duct in its widened ectal part. 14. Cross section of a calciferous gland in the ectal half. 15. The same in the ental half.

body; which is as long as $2/3$ IX, so that it does not attain septum $8/9$. The gland body presents a thick stroma with lengthwise wavy non-ciliated canaliculi; which grow in size towards the anterior (i.e. distal) region of the gland, where they open into the gland cavity. The cavity is central axial throughout the gland, presenting high ciliated epithelium. It is narrow and slit-like ectally (Fig. 14) widening and making some longitudinal folds entalwards (Fig. 15). The transition oesophagus - intestine is in XII. There are no typhlosole or intestinal caeca. There is a bulky supra-oesophageal vessel in X - XI, linked to two oesophageal-hearts of thin walls. One pair of lateral-hearts is posterior in IX; its dorsal half is thin but with very muscular thick walls, and its ventral half is turgid with thin walls. There are one pair of avesculated holonephridia per segment.

Two pairs of testis and male funnels are ventral in X and XI. There are no testis sacs and the spermatozoan fill up the cavity of both the segments. Two pairs of lobular seminal vesicles are in IX and XII. Those of XII are the bigger ones; they stretch the septum $12/13$ out to occupy XII - XIII. The two male ducts of every side run along the body wall in a common sheath; they coalesce inside the papilla of XVII a little before joining the corresponding prostate duct, and open through the male pore. Each prostate has a small thin muscular duct as long as one segment and without ectal dilation. It follows the glandular part; which is tubular, about two times thicker and ending in XXII after some turns below the intestine. One pair of ovaries and female funnels are ventral in XIII. The spermathecae pair in IX (Figs 12) has egg-shaped ampulla well separated from the duct; which is about 1.5 times longer and widened in its ectal portion. The duct has a connective very vascularized coat over thin muscular sheath. In its widened portion the connective coat is a little thicker and the high inner epithelium build up 7 - 8 chambers widely opened into the duct cavity (Fig. 13). The longer non-widened ental portion of the duct has a smooth inner surface. Free spermatozoan are found throughout the duct, in the ampulla they are surrounded by an amorphous pale-blue stained mass.

REMARKS - *Ocnerodrilus potyuara* is set apart from the other species of the genus by the intraparietal chambers in the widened ectal part of the spermathecae duct. This characteristic places it on the bordering zone to *Pygmaeodrilus*, characterized by possessing diverticles in the spermathecae. Outside this, *O. potyuara* is near to *O. calwoodi* and *O. simplex*. Other main characteristics to distinguish these species from *O. potyuara* are: *O. calwoodi* - setal space $aa = bc$; male porophores taking over all XVII length and a little more. *O. simplex* - Arciform muscles only in XVII; spermathecae without distinction between duct and ampulla. The name of the new species is that of an indian group of the region, also named "Potyuara".

Liodrilus Eisen, 1900

Ocnerodrilus (part.); Beddard, 1891: 56.

Ocnerodrilus (*Leiodrilus*) Eisen, 1900: 112.

Ocnerodrilus (*Liodrilus*); Michaelsen, 1900: 378; Stephenson, 1930: 861.

Ocnerodrilus (*Guamaia*) Righi, 1975: 77.

DIAGNOSIS - Setae, eight per segment. Dorsal pores absent. One pair of joined male and prostatic pores in XVII with or without copulatory chambers. One or two pairs of spermathecal pores in 7/8 or 7/8 and 8/9. Gizzard absent. One pair of calciferous glands in IX of panicked-tubular structure. One pair of ovaries in XIII. Spermathecae without diverticles or seminal chambers.

TYPE - *Ocnerodrilus eiseni* Beddard, 1891.

REMARKS - Until now *Liodrilus* has been known only by the type-species as no more have been found since the original description. BEDDARD (1891) wrote about the calciferous gland structure of *L. eiseni* - "their lumen is divided by a network of anastomosing folds of epithelium, the subdivisions being more complete towards the blind end of the gland. The epithelium of the glands appears to be everywhere ciliated..." This description fits the structure of the glands in *Ocnerodrilus (Guamaia) ipu* Righi, 1975, therefore the proposed synonymy, notwithstanding the difference in the spermathecae number.

SPECIES AND OCCURRENCES

L. eiseni (Beddard, 1891) - Guyana.

L. ipu (Righi, 1975) - Brazil: Pará State: Belém.

L. mendesi, n. sp. - Brazil: Paraiba State. João Pessoa.

TABLE FOR THE *Liodrilus* SPECIES

Species	<i>eiseni</i>	<i>ipu</i>	<i>mendesii</i>
Clitellum	XIII - XVIII	XIII - XIX	XIV - XX
Glandular cushion	absent	absent	XVI - XVIII, aa
Spermathecal pores	7/8, ab	7/8 and 8/9, b	7/8 and 8/9, b
Spermathecae shape	Rounded, sessile	Flattened globular ampulla, short straight duct	Cylindrical ampulla, bent long duct.
Setae	closely paired	widely paired	widely paired

Liodrilus mendesi, n. sp.

(Figs 16-26)

MATERIAL - Brazil: Paraiba State: João Pessoa, moist sandy soil, holotype 1 clitellate worm (ZU-1275A), paratypes 1 clitellate and 1 mature a clitellate worms (MHNG 992.134) and 2 mature a clitellate worms (ZU-1275B), Everaldo G. da Silva col. 24.IV. 1992.

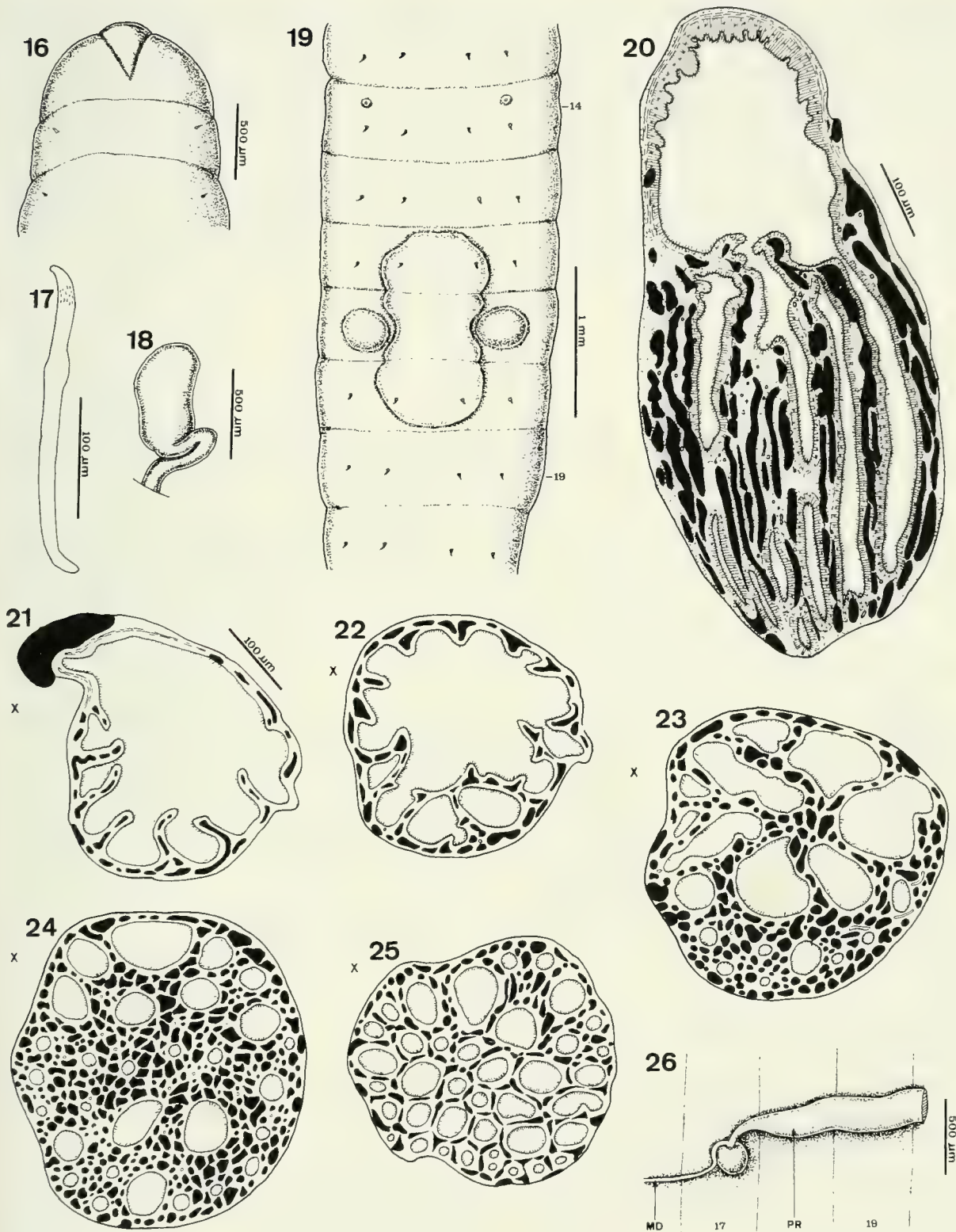
DESCRIPTION - Length 50 - 60 mm. Mid-body diameter 1.3 - 1.4 mm. Number of segments 155 - 175. The pre-clitellar dorsal region is violet-blue like no. 590 of Sèguy (1936); the remaining part is dirty white. The prostomium is epilobous 2/3 of V-like tongue (Fig. 16). The setae are arranged in four pairs of longitudinal series starting from II. There are no ventral setae in XVII or modified genital setae. The setal

relations are in the mid-body region (segments LXV - LXXV) $aa : ab : bc : cd : dd = 1.42 : 1.00 : 1.90 : 1.35 : 1.55$ ($ab = 399 \mu\text{m}$) and in the posterior region (CXL - CL) $= 1.44 : 1.00 : 1.42 : 1.08 : 1.27$ ($ab = 309 \mu\text{m}$). The setae (Fig. 17) are lengthened sigmoid with a distal nodulus and unicuspidate apex. The subapical part has small marks which are a little longer than they are wide and irregularly placed or in more or less oblique rows. The setae length varies in the mid-body region from 235 - 256 μm ($M = 242 \mu\text{m}$) and in the posterior region from 225 - 245 μm ($M = 236 \mu\text{m}$).

The clitellum extends on XIV - XX (= 7 segments) and is ventrally opened in *bb*; its intersegmental furrows are unrecognizable. The male pores are situated on a pair of rounded to eggshaped papillae in XVII *ab*. One glandular area is prominent on the ventral face of XVI - XVIII (Fig. 19) of clitellate and mature aclitellate worms. This area shows small indents in the intersegments and a strong waist between the male papillae. The female pores are on small papillae in the fore part of XIV, line *b*. Two pairs of minute spermathecal pores open out on line *b* of 7/8 and 8/9. Nephridiopores are not visible.

The septa 4/5 and 5/6 are very thin and 6/7 - 8/9 are thick and muscular. The following septa become thinner and thinner to 11/12 and the other ones are very slender. The septal glands extend up to VII. The pharyngeal bulb distends the septa backwards extending to parietal segment VI. There is no gizzard. One pair of calciferous gland open into the posterior portion of the oesophagus in IX. Each gland has a short peduncle turned forwards and downwards and gradually enlarges. Its inner epithelium is high and ciliated building up two small irregular folds. The transition between peduncle and glandular body forms a small angle without a sharp change in diameter. The egg-shaped gland body grows downwards and forwards did not reaching the septum 8/9. The most ectal region of the gland (Figs 20 - 21) has a wide cavity with lengthwise trabeculae. The trabeculae coalesce entalwards successively two by two (Fig. 22) originating peripheral longitudinal ducts. Afterwards the trabeculae coalesce medially giving rise to more central ducts (Fig. 23). All ducts are longitudinal; they undergo dichotomies forming other thinner ducts (Fig. 24); which may widen in the ental region (Fig. 25). The surface of the ectal cavity and ducts are ciliated everywhere. Among the ducts there is a stroma of loose connective tissue with numerous lengthwise blood spaces. Rare and minute canaliculi are seen in the stroma; they may be real or only technical artifacts. Rounded to egg-shaped spaces are sporadically seen inside the ducts walls; their diameter varies between 6 - 10 μm , and they contain very small grey to black granules. Similar granules are found in all duct lumen. The transition oesophagus - intestine is in 12/13. There are no typhlosole or caeca. Two pairs of bulky hearts are in X and XI and one pair of avesculate holonephridia in each segment.

Two pairs of testis and male funnels are ventral in X and XI; there are not testis sacs, the cavity of the segments are full of spermatozoan. Two pairs of nodular surface seminal vesicles are in IX and XII; there are no seminal vesicles in X and XI. The two male ducts on each side have a common sheath. They run straight along the body wall to 1/2 XVII, where they bend medialwards and ascend slightly into the body cavity. Then they coalesce and the sheath becomes two times thicker and



FIGS 16-26

Liodrillus mendesi: 16. First three segments in dorsal view. 17. Posterior seta. 18. Spermatheca of 7/8. 19. Ventral view of the segments XIV - XIX. 20. Sagittal section of a calciferous gland. 21 - 25. Cross sections of a calciferous gland from ectal (21) to ental (25) regions; same scale. 26. Terminal part of the male apparatus in inner view. MD = male duct. PR = Prostate X = position of the oesophagus.

muscular. The resulting single duct coalesce with the corresponding prostatic duct and penetrates medially into the rounded and very muscular copulatory chamber or ejaculatory bulb (Fig. 26). Each prostate of XVII has a short and little muscular duct; it continues without transition through the tubular glandular portion; which extends to XXVII ventrally. One pair of fan-shaped ovaries and female funnels lie in XIII and two pairs of spermathecae in VIII and IV. On each spermatheca (Fig. 18) the duct is muscular folded and as long as the cylindrical to fusiform ampulla.

The name of the new species is an homage to Prof. Erasmo Garcia Mendes.

Lourdesia, n. gen.

DIAGNOSIS - Setae, eight per segment. Dorsal pores absent. One pair of united male and prostatic pores in XVII. One pair of spermathecal pores in 8/9. Gizzards, three in VI, VII and VIII. One pair of calciferous gland in IX; their cavity is wide in the peduncle and divided into 7 - 8 longitudinal ducts in circular arrangement to each other inside the gland body stroma. One pair of free testis and male funnels in XI. Male and prostatic ducts without special ectal differentiation. One pair of ovaries in XIII. One pair of spermathecae without diverticles or seminal chambers in IX.

TYPE - *Lourdesia paraibaensis*, n. sp.

REMARKS - *Lourdesia* has affinities to *Ilyogenia* Beddard, 1892 (= *Phoenicodrillus* Eisen, 1895; Gates, 1977), known from Africa and Tropical America, and to *Temanoegia* Gates, 1979, endemic in Hispaniola Island (Dominican Republic). The main characteristics to distinguish these two genera from *Lourdesia* are: *Ilyogenia* - Gizzard absent; testis in X and XI. *Temanoegia* - Gizzards, two in VI and VII; "solid" calciferous gland, i. e. there are no cavity.

The name of the new genus is an homage to Dr. Lourdes Abbut Righi.

Lourdesia paraibaensis, n. sp.

(Figs 27-31)

MATERIAL - Brazil: Paraiba State: João Pessoa, most sandy soil of forest; holotype 1 clitellate worm (ZU-1274A), paratypes 2 clitellate worms (ZU-1274B) and 1 clitellate worm (MHNG 993.124). Rafael A. T. Guerra col. 29.V.1992.

DESCRIPTION - Length 32 - 42 mm. Mid-body diameter 0.8 - 0.9 mm. Number of segments 92 - 101. Pigments absent. Protomium epilobus 1/3 of V-shaped tongue. The setae are placed in 4 longitudinal series beginning from II. There are no ventral setae in XVII. The setal relations are in the mid-body region (segments XXV - XXX) $aa : ab : bc : cd : dd = 9.8 : 1.0 : 9.6 : 1.0 : 15.6$ and in the posterior region (LXXX - XC) = $4.8 : 1.0 : 5.4 : 1.0 : 8.8$ ($ab = 64 \mu\text{m}$ in both regions). The setae (Fig. 30) are sigmate with a short distal curve and a wide proximal one; their unicuspidate apex is not ornamented. The setae length varies in the mid-body region from 82 - 97 μm ($M = 88 \mu\text{m}$) and in the posterior region from 117 - 148 μm ($M = 131 \mu\text{m}$). There are no

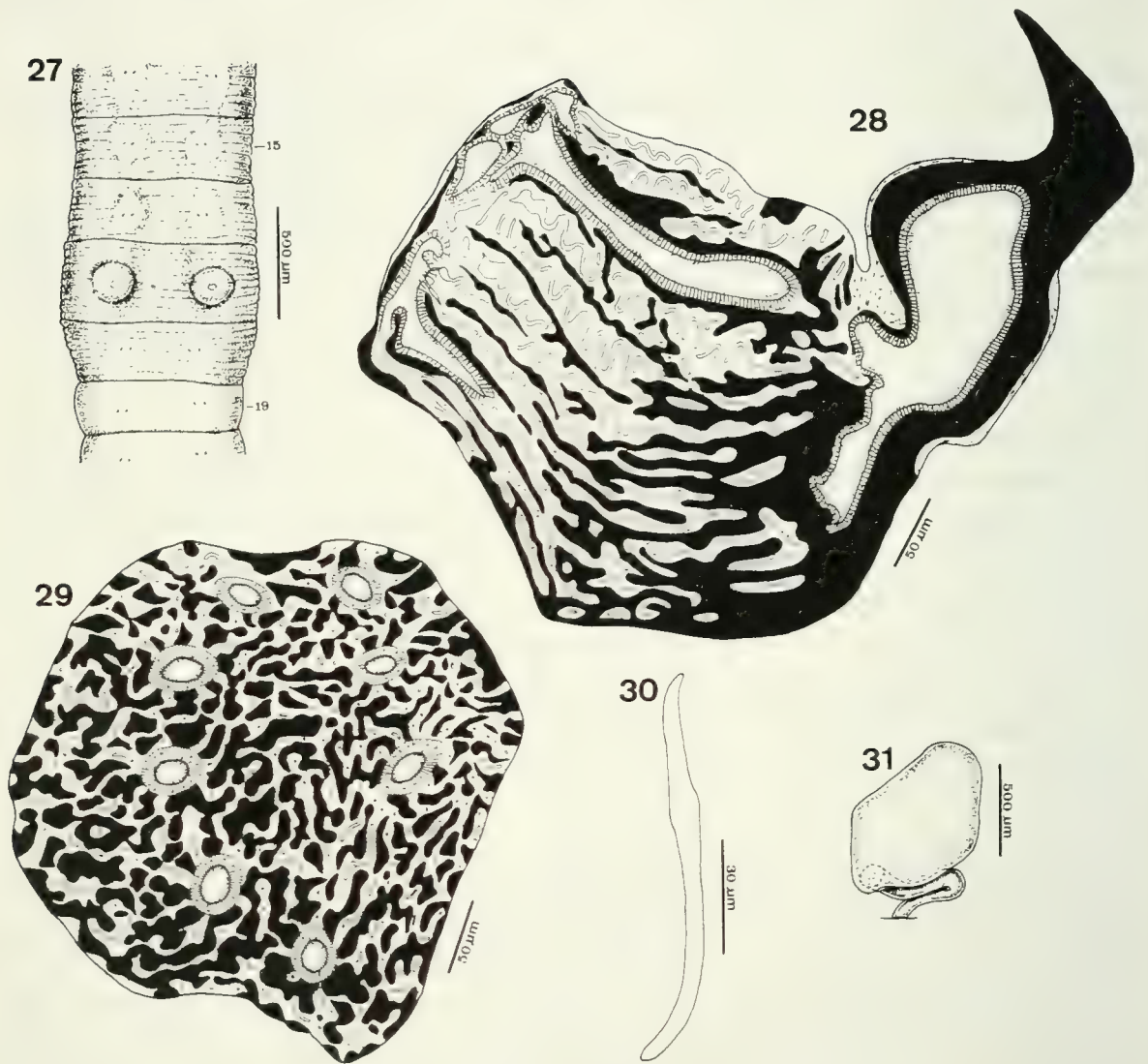
genital setae. The ring-shaped clitellum is thicker dorsally and goes from XIV - XVIII (= 5 segments); it may be also slightly differentiated in XIII. In three worms the surface of the clitellum has a lot of annular furrows deeper in the flat or slightly sunk ventral face. The voluminous conical male papillae are in XVII; their center is on line *b* or just laterally (Fig. 27). The female pores lie in the anterior third of XIV, laterally to *b* line; sometimes they are like a small papilla. One pair of spermathecal pores open in $1/2 bc$ of $8/9$. They are like small transverse slits sometimes with slightly tumid lips and sometimes not. There are no dorsal pores. The nephridiopores are unrecognizable.

The septa 5/6 - 11/12 are conical, the others are flat. The septa 5/6 - 7/8 are very thick and muscly, the followings thin successively to 10/11 or 11/12 and the others are slender and fragile. A lot of oblique muscular bands (arciform musculature) join the lateral body walls to the ventral one at the sides of the nerve-cord in XIV - XVIII; the bands are more numerous in XVII. The pharyngeal bulb extends to V; its glands make a covering over the anterior oesophagus; which makes a dorsal loop in V. Three wide egg-shaped very muscular gizzards lie in VI - VIII; they are separated by short oesophageal portions. One pair of calciferous glands opens into the postero-ventral region of the oesophagus in IX. On each gland the peduncle is at a right angle to the gland body; which is egg-shaped, almost as wide as it is long, and its length is $1/2 - 3/4$ of the IX segment length. The main cavity of the gland is restricted to the peduncle (Fig. 28). In the proximal part of the gland body the cavity splits out into 7 - 8 lengthwise ducts (Figs 28 - 29) 19 - 30 μm wide. The ducts have circular disposition to each other. A lot of longitudinally wavy canaliculi follow at the sides of the ducts; their diameter is 3 - 5 μm in the mid part of the gland widening towards the distal (i. e. anterior in the worm) part of the gland; where they join to the ducts. There also seem to be cross communications between the canaliculi. Ducts and canaliculi are intremingled with loose connective tissue and lengthwise blood spaces with cross connections. The main cavity of the calciferous gland and its ducts are ciliated but not the canaliculi. The oesophagus is simple to 12/13 where the intestine begins. There is no typhlosole or intestinal caeca. The intestine is filled up by vegetable debris and some sand grains. Two pairs of voluminous oesophageal-hearts lie in X and XI. There are one holonephria pair on each segment.

One pair of large testis are fastened to the postero-ventral surface of the septum 10/11; the cavity of XI is filled up by developing spermatozoan. One pair of shield-like seminal vesicles are in XII. The wide and folded male funnels of XI continue along the male ducts; these lie on the body wall right to XVII, where they pierce the corresponding male papillae. The pair of prostates extends from XVII - XXIV, XXV. On each prostate the duct is limited to XVII and it is $1/2$ as wide as the prostate glandular region. This is simple tubular and ventral to the intestine. Each male papilla is a massive muscular structure and protrudes somewhat into the body cavity. The male and prostate ducts run side by side through the papilla; their lumina coalesce at the epithelium level or just below. One pair of thin conical ovaries are in XIII; each one has only one apical mature egg. The pair of spermathecae is very voluminous in IX. Each spermatheca (Fig. 31) is made up of a folded long duct without diverticles or seminal chambers and of a wide irregularly egg-shaped ampulla

of thin wall. The ampulla is filled up by spermatozoan balls intermingled with a pale-blue stained mucous mass. The duct contain free spermatozoan.

The name of the new species is that of the place of collection.



FIGS 27-31

Lourdesia paraibaensis: 27. Ventral view of the segments XV - XIX. 28. Sagittal section of a calciferous gland. 29. Mid-cross section of a calciferous gland. 30. Mid-body seta. 31. Spermatheca.

BIBLIOGRAPHY

- BEDDARD, F. E. 1891. On the anatomy of *Ocnerodrilus* (Eisen). *Trans R. Soc. Edinburgh* 36 (2): 563 - 585, 1 pl.
- BEDDARD, F. E. 1892. On some new species of Earthworms from various parts of the world. *Proc. zool. Soc. Lond.* 1892: 666 - 706, pls. 45 - 46.
- BEDDARD, F. E. 1895. A Monograph of the Order of the Oligochaeta. *Clarendon Press, Oxford*, X + 769 pp.
- BEDDARD, F. E. 1906. Zoological Results of the Third Tanganika Expedition, conducted by Dr W. A. Cunnington, 1904-1905. Report on the Oligochaeta. *Proc. zool. Soc. Lond.* 1906 (1): 206 - 218.
- COGNETTI DE MARTIIS, L. 1902. Viaggio del Dr A. Borelli nel Chaco boliviano e nella Republica Argentina XVII. Terricoli boliviani ed argentini. *Boll. Mus. Torino* 17 (420): 1 - 11, 1 pl.
- COGNETTI DE MARTIIS, L. 1904. Nuovi Oligocheti di Costa Rica. *Boll. Mus. Torino* 19 (478): 1 - 4.
- COGNETTI DE MARTIIS, L., 1905a. Oligocheti raccolti nel Darien dal Dr. E. Festa. *Boll. Mus. Torino*, 20 (495): 1 - 7.
- COGNETTI DE MARTIIS, L. 1905b. Gli Oligocheti della Regione Neotropica. Parte prima. *Mem. R. Accad. Sc. Torino* (2) 55: 1 - 72, 1 pl.
- COGNETTI DE MARTIIS, L. 1906. Contributo alla conoscenza della drilofauna delle isole Canarie. *Boll. Mus. Torino* 21 (521): 1 - 4.
- EISEN, G. 1878. On the Anatomy of *Ocnerodrilus*. *Nova Acta R. Soc. Sci. Upsaliensis* (3) 10 (4) 12 pp., 2 pls. (*apud* Beddard, 1891).
- EISEN, G. 1893. Anatomical studies on new species of *Ocnerodrilus*. *Proc. Calif. Acad. Sc.* (2) 3: 228 - 290, pls. 5 - 10.
- EISEN, G. 1895. Pacific Coast Oligochaeta I. *Mem. Calif. Acad. Sc.* 2 (4): 63 - 122, pls. 30 - 45.
- EISEN, G. 1900. Researches in American Oligochaeta with special reference to those of the Pacific Coast and adjacent islands. *Proc. Calif. Acad. Sc.* (3) 2: 84 - 276, pls. 5 - 14.
- GATES, G. E. 1972. Burmese earthworms. *Trans Amer. Phil. Soc.* (N.S.) 62 (7): 1 - 326.
- GATES, G. E. 1973. Contributions to North American earthworms (Annelida) 7. Contribution to a revision of the earthworm family Ocnerodrilidae, IX. What is *Ocnerodrilus occidentalis*? *Bull. Tall Timbers Res. Stat.* 14: 13 - 28.
- GATES, G. E. 1977. La faune tereestre de l'Île de Sainte-Hélène. Oligochaeta. *Ann. Mus. R. Afr. Centrale-Tervuren* (Zool.) 220: 469 - 491.
- GATES, G. E. 1979. A new genus of larger Ocnerodrilid earthworms in the American hemisphere. *Megadrilologica* 3 (9): 162 - 164.
- JAMIESON, B. G. M. 1957. Some speices of *Pygmaeodrilus* (Oligochaeta) from East-Africa. *Ann. Mag. nat. His.* (12) 10: 449 - 470.
- JAMIESON, B. G. M. 1963. A Revision of the Genus *Gordiodrilus* Beddard (Oligochaeta: Megascolecidae). *Bull. Brit. Mus. (Nat. Hist.)* 9 (8): 299 - 323.
- JAMIESON, B. G. M. 1971. A Review of the Megascolecoid Earthworm Genera (Oligochaeta) of Australia. Part I. Reclassification and Check list of the Megascolecoid Genera of the World. *Proc. R. Soc. Queensland* 82 (6): 75 - 86.
- MICHAELSEN, W. 1890. Beschreibung der von Herrn Dr. Franz Stuhlmann im Mündungsgebiet des Sambesi gesammelten Terricolen. *Mitt. Mus. Hamburg* 7: 21 - 50, pls. 1 - 4.
- MICHAELSEN, W. 1899. Beiträge zur Kenntniss der Oligochäten. *Zool. Jahrb. Syst.* 12: 105 - 144.
- MICHAELSEN, W. 1900. Oligochaeta. Das Tierreich, 10: *R. Friedlander und Sohn, Berlin*, XXIX + 575 pp.

- MICHAELSEN, W. 1911. Die Oligochaeten des inneren Ostafrika und ihre geographischen Beziehungen. *Wiss. Ergebn. Deutsch. Zentral-Afrika Exped. 1907-8* vol. 2 (Zool. 1): 1 - 90, pls. 1 - 2.
- MICHAELSEN, W. 1913. Die Oligochaeten Columbias. *Mém. Soc. neuchât. Sc. nat.* 5: 202 - 252, pl. 8.
- MICHAELSEN, W. 1914. Oligochäten von tropischen Afrika. *Mitt. Mus. Hamburg* 31 (2): 81 - 127, 1 pl.
- MICHAELSEN, W. 1915. Oligochaeta. In *Voyage de Ch. Alluaud et R. Jeannel en Afrique orientale, 1911 - 1912. Résultats scientifiques. Vermes II*: 23 - 42, pl. 2.
- MICHAELSEN, W. 1924. Oligochäten von den wärmeren Gebieten Amerikas und des Atlantischen Ozeans. *Mitt. Mus. Hamburg* 41: 71 - 83.
- MICHAELSEN, W. 1936. Oligochäten von Belgisch-Kongo. III. *Rev. zool. bot. Afr.* 29 (1): 37 - 72, pl. 3.
- PANTIN, C. F. A. 1964. Notes on Microscopical Technique for Zoologists. *University Press, Cambridge*, VIII + 77 pp.
- RIGHI, G. 1968. Sobre alguns Oligochaeta do Brasil. *Rev. Brasil. Biol.* 28 (4): 369 - 382.
- RIGHI, G. 1975. Some Oligochaeta from the Brazilian Amazonia. *Stud. Neotrop. Fauna* 10: 77 - 95.
- RIGHI, G. 1981. Alguns Oligochaeta cavernícolas do Equador. *Papéis Avulsos Zool., S. Paulo* 34 (22): 235 - 249.
- RIGHI, G. 1984. On a Collection of Neotropical Megadrili Oligochaeta, I. Ocnerodrilidae, Acanthodrilidae, Octochaetidae, Megascolecidae. *Stud. neotrop. Fauna* 19 (1): 9 - 31.
- RIGHI, G. 1988. Uma coleção de Oligochaeta da Amazônia brasileira. *Papéis Avulsos Zool., S. Paulo* 36 (30): 337 - 351.
- RIGHI, G. 1990. Minhocas de Mato Grosso e de Rondônia. *Cons. Nac. Pesq., Brasília*, 157 pp.
- RIGHI, G. & FRAILE MERINO, J. 1987. Alguns Oligochaeta de Costa Rica. *Rev. Brasil. Biol.* 47 (4): 535 - 548.
- ROSA, D. 1895. Viaggio del dottor Alfredo Borelli nella Republica Argentina e nel Paraguay. XV. Oligocheti terricoli. *Boll. Mus. Torino* 10 (204): 1 - 3.
- ROSA, D. 1896. Contributo allo studio dei Terricoli Neotropicali. *Mem. R. Accad. Sc. Torino* (2) 45: 89 - 152, pl. 1.
- SÉGUY, E. 1936. Code universel des couleurs. *Paul Lechevalier ed. Paris*, 78 pp. 55 pls.
- STEPHENSON, J. 1923. Oligochaeta. The Fauna of British India. *Taylor & Francis, London*, XXIV + 518 pp.
- STEPHENSON, J. 1930. The Oligochaeta. *Clarendon Press, Oxford*, XVI + 978 pp.